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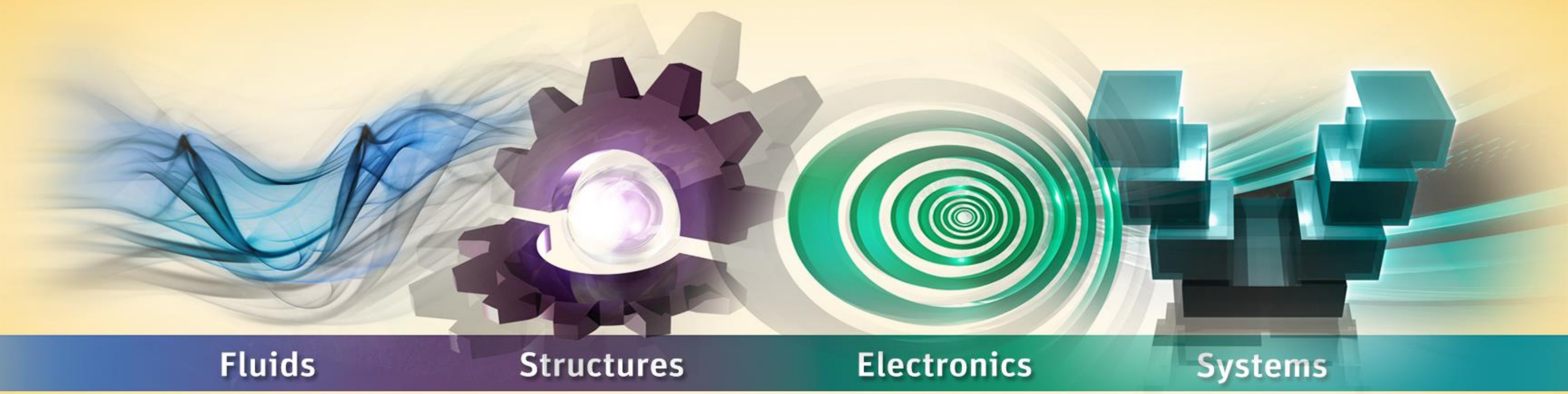
Realize Your Product Promise®

Virtual System Prototyping

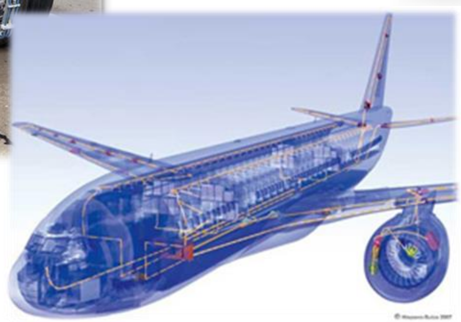
Modeling & Simulation with Simplorer

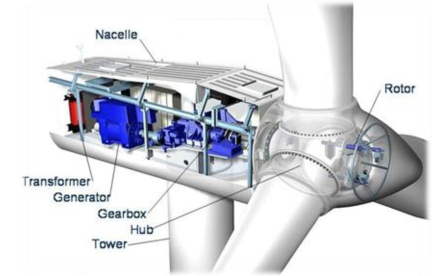


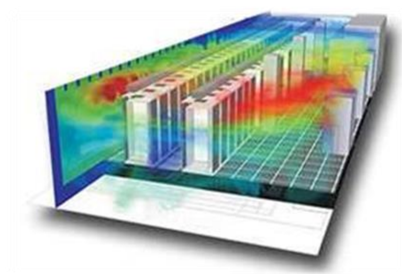
ANSYS CONVERGENCE

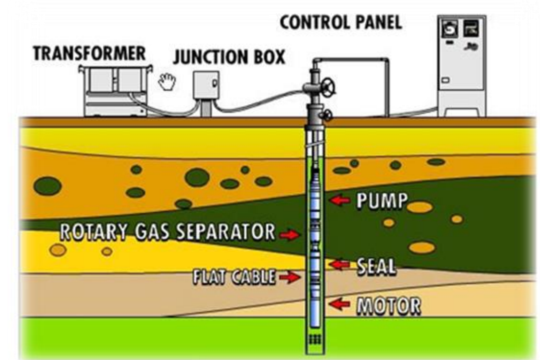
2015 REGIONAL CONFERENCES

Electrified Systems – They’re Everywhere









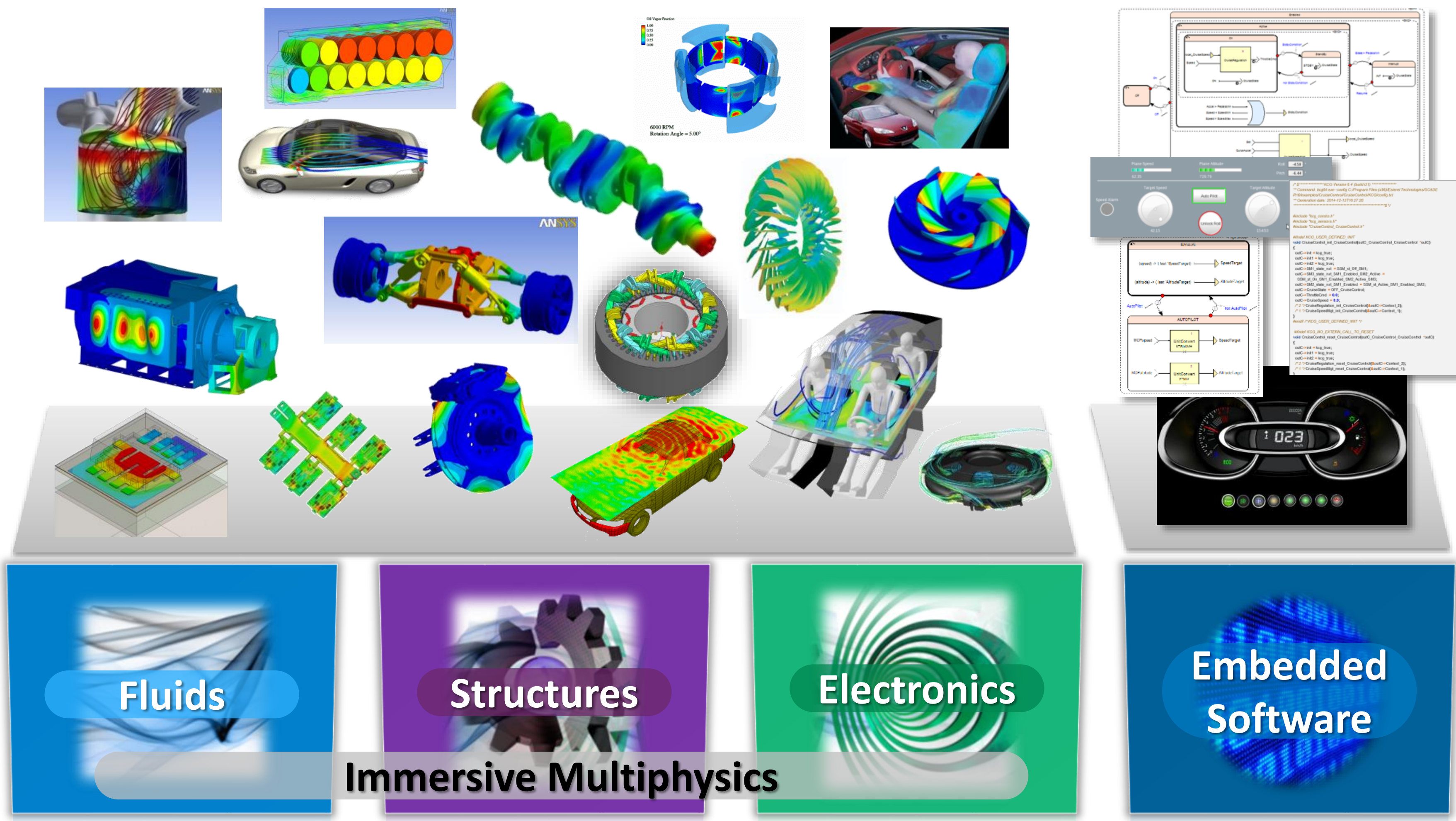
It’s an opportunity to innovate…

- Powering, Actuating, Sensing, Controlling products in new ways

…with a lot at stake

- Better performance
- Higher efficiency
- Lower cost
- Higher reliability

Comprehensive Component-Level Design



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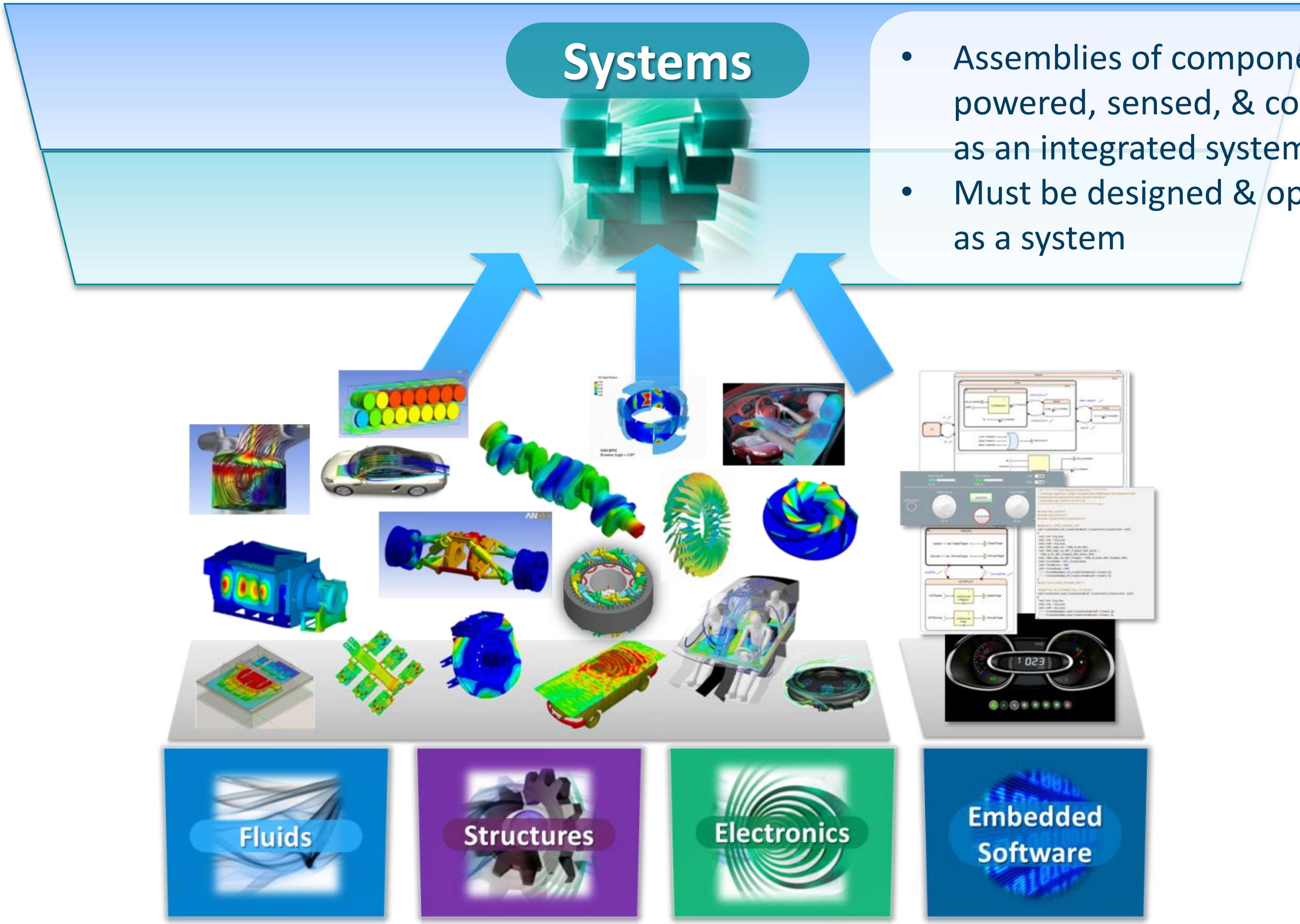
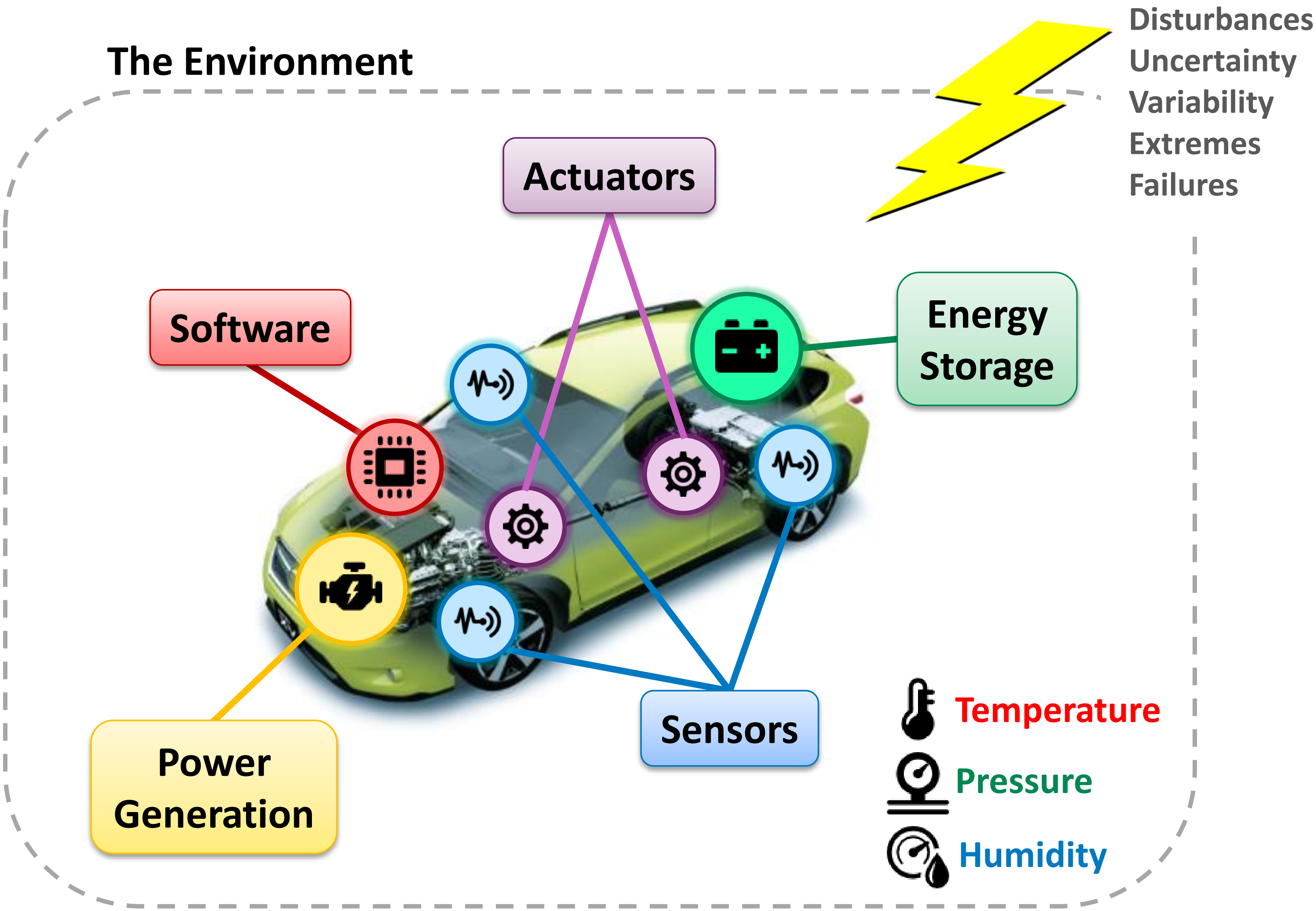
The Next Level: Systems

- Assemblies of components – powered, sensed, & controlled as an integrated system
- Must be designed & optimized as a system



What is a System?



Why is System Simulation Useful?

At the start of the design process

- Early Architectural Tradeoffs
- “Simulation-in-the-loop” for predictive studies
- Pre-Sales / Collaboration tool

During the design process

- Embedded Control Algorithm Design / Tuning
- System Verification / Validation
- Virtual Integration

At the end of the design process

- System Performance Optimization
- Robust Design

After the design process has been completed

- Predictive Maintenance
- Adaptive Controls Tuning

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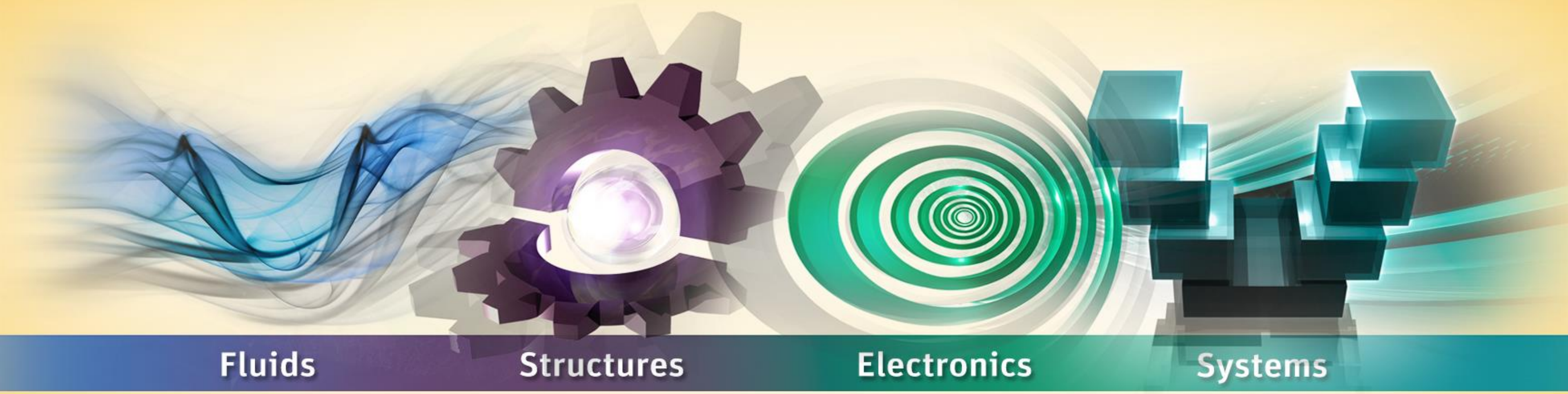
A System Example

Electric Vehicle Drivetrain



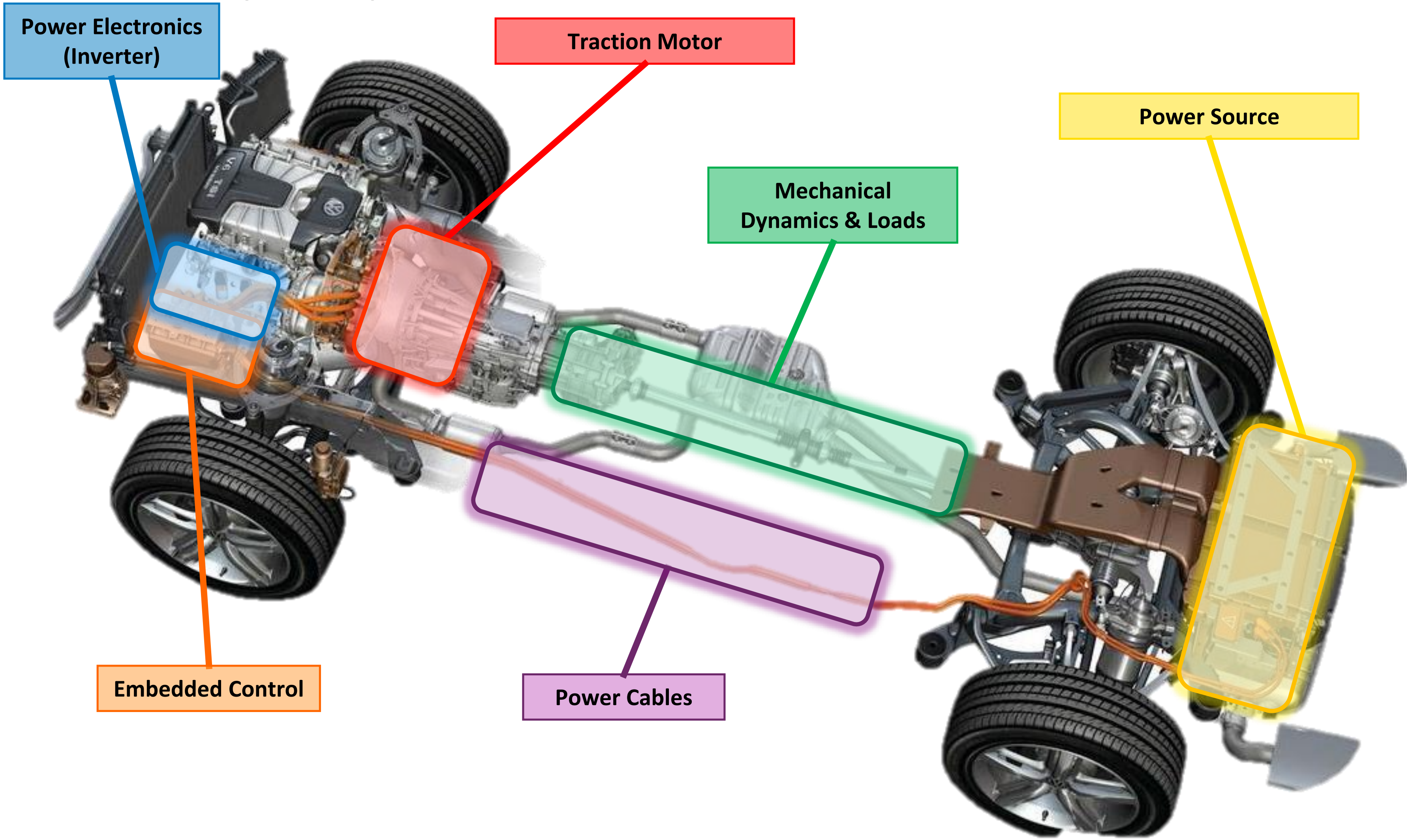
Electric Vehicle Drivetrain

Key System-Level Considerations

- System Cost
- Reliability / Warranty
- Package Size
- Energy Efficiency
- Safety Integrity
- Drive Quality

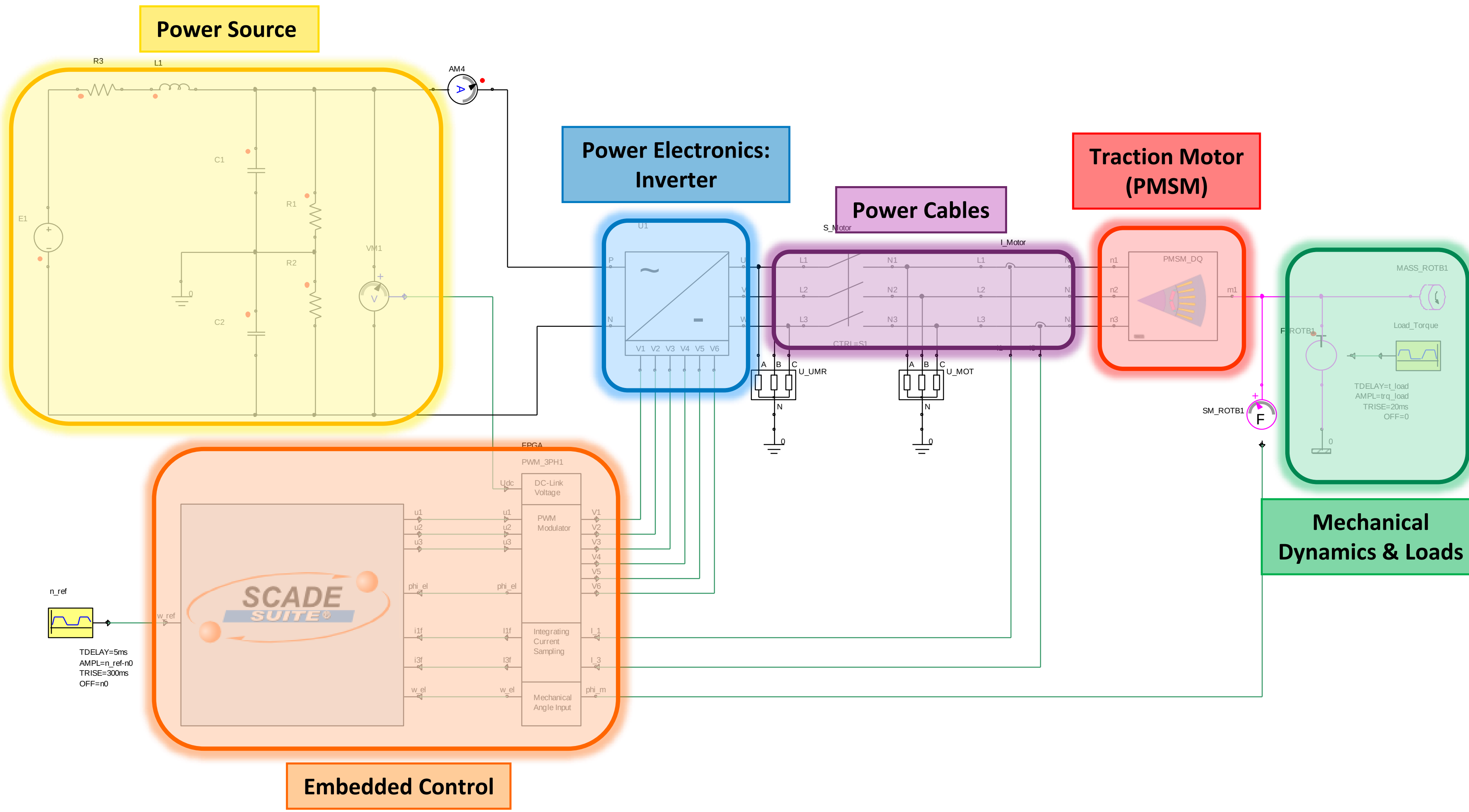
Electric Vehicle Drivetrain

Key Components



Electric Vehicle Drivetrain

As a System Model



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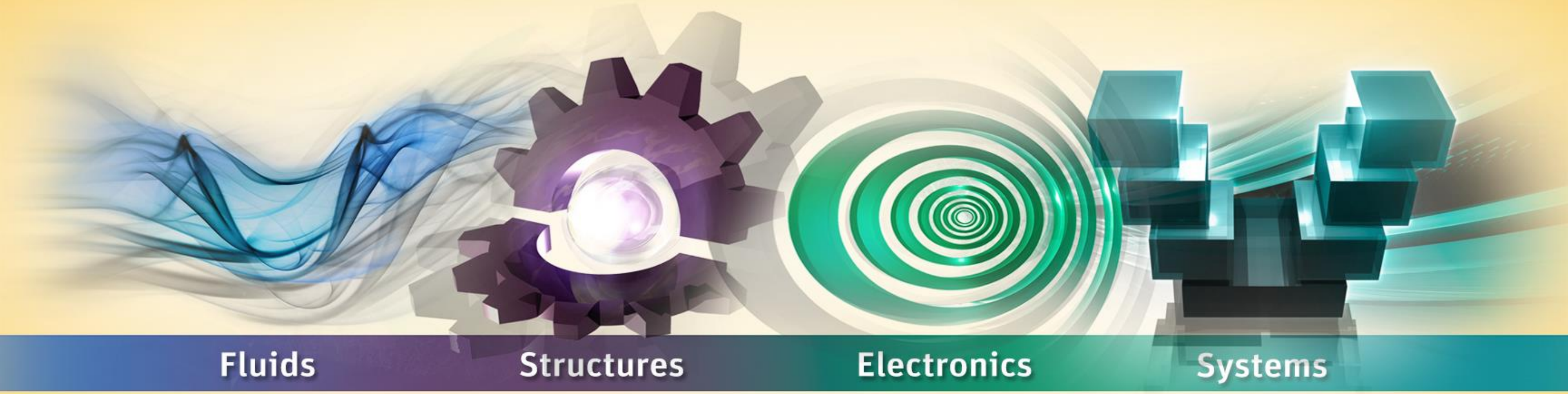
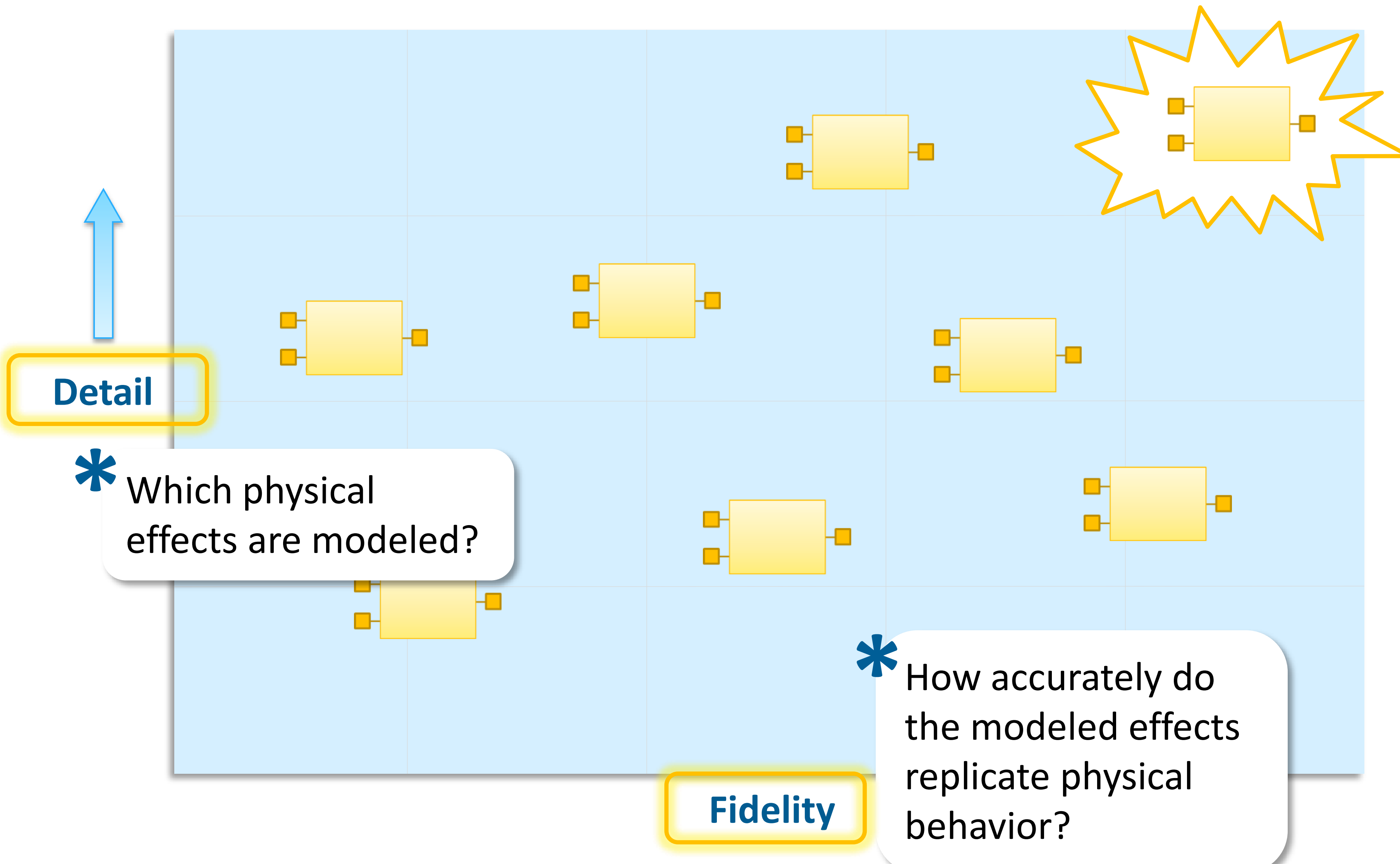
System Modeling

Detail & Fidelity



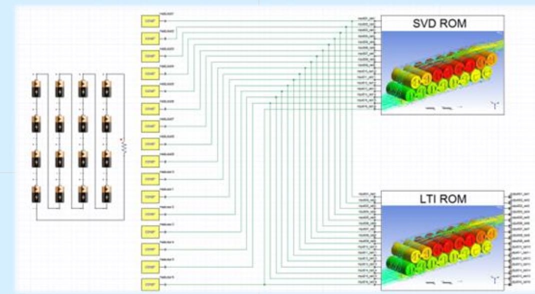
Model Detail & Fidelity



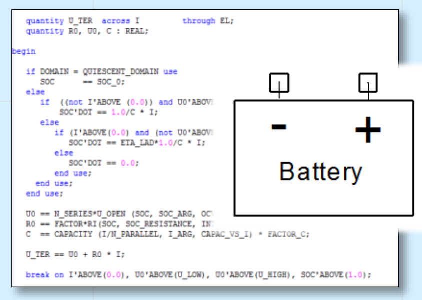
Modeling the EV System

Power Source

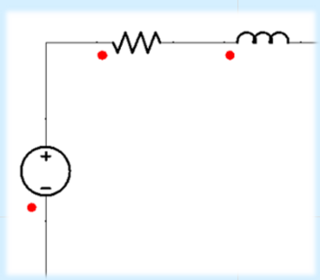
Detail



Equivalent Circuit Model
+ CFD ROM



VHDL-AMS
Behavioral Model



Basic Equivalent
Circuit

Fidelity

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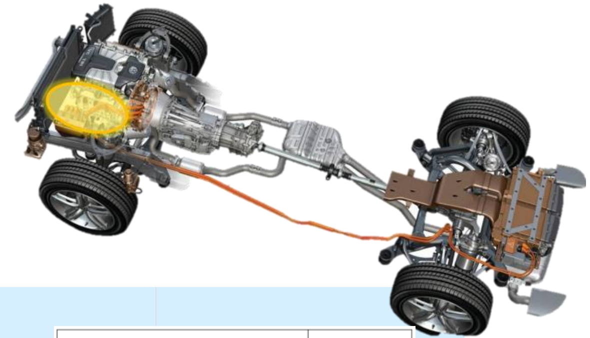
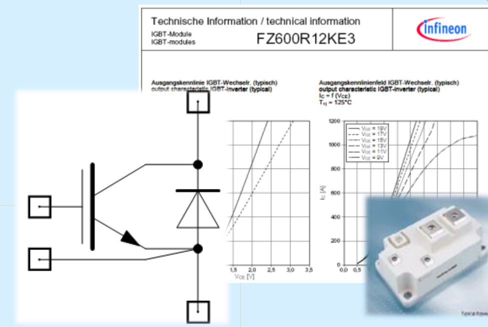
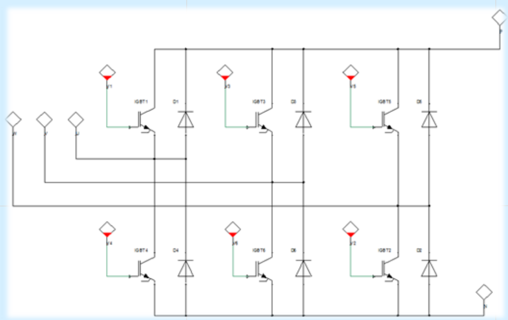
Modeling the EV System

Power Electronics: Inverter

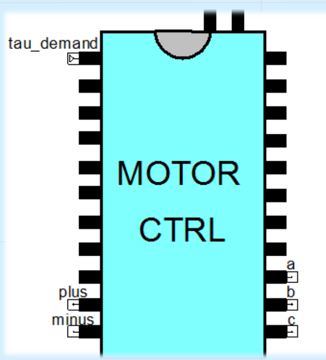




3-phase Inverter with Dynamic Thermal IGBTs



3-phase Inverter with Ideal IGBTs



State-Averaged Controller

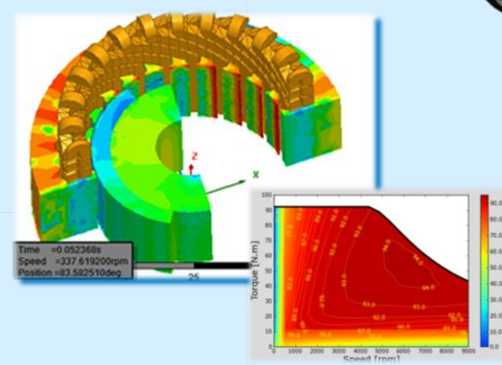
Detail

Fidelity

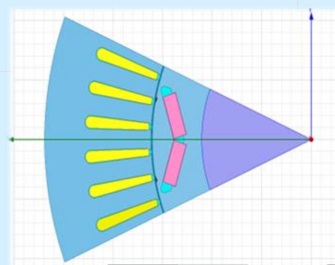
Modeling the EV System

Traction Motor

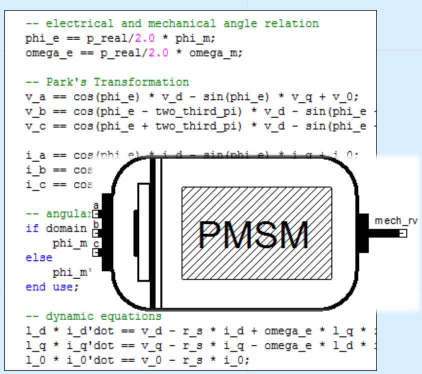
Detail



Co-simulation with 2D/3D FEM



Electric Circuit Equivalent ROM



VHDL-AMS Behavioral Model

Fidelity

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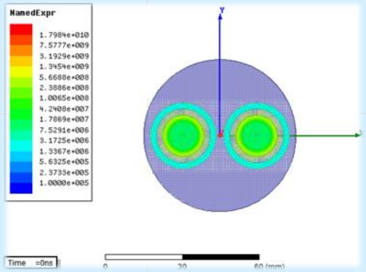
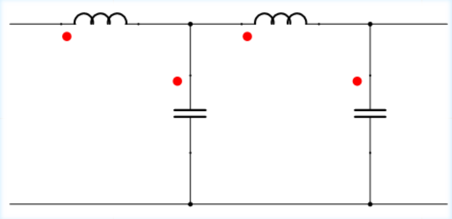
Modeling the EV System

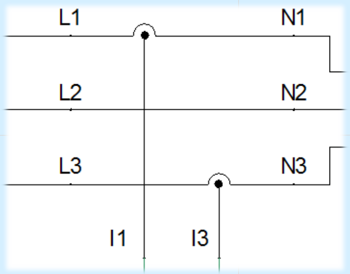
Power Cables



S-Parameter ROM
for Distributed Tx Lines



Lumped Element
Lossless Model



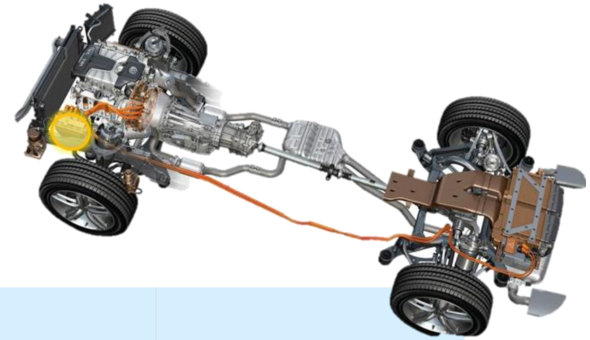
Ideal Connections

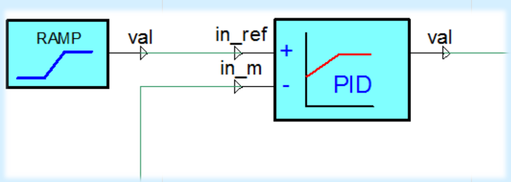
Detail

Fidelity

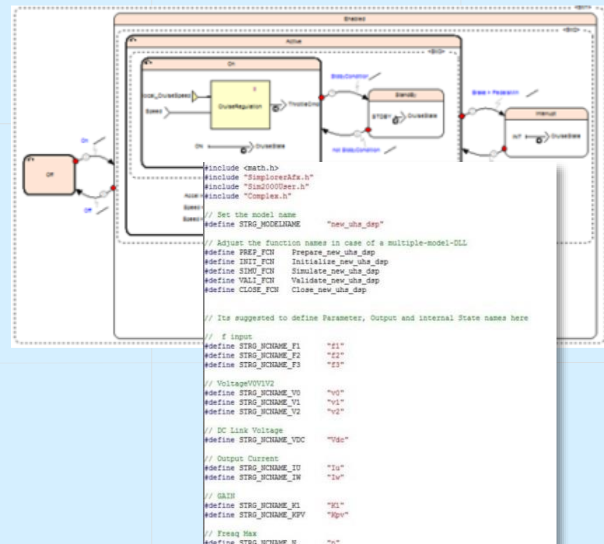
Modeling the EV System

Embedded Control





Ideal Control Blocks



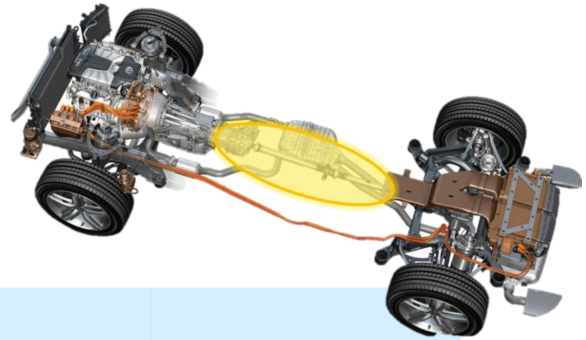
Generated Control Application Code

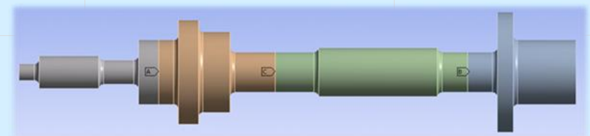
Detail

Fidelity

Modeling the EV System

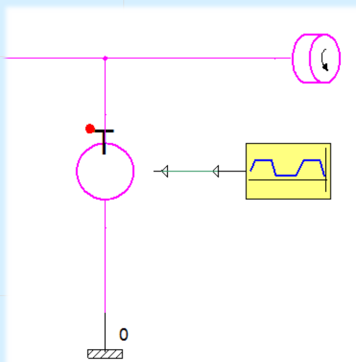
Mechanical Dynamics





Mechanical ROM of Flexible Shaft

Detail



Lumped Element Mechanical Effects

Fidelity

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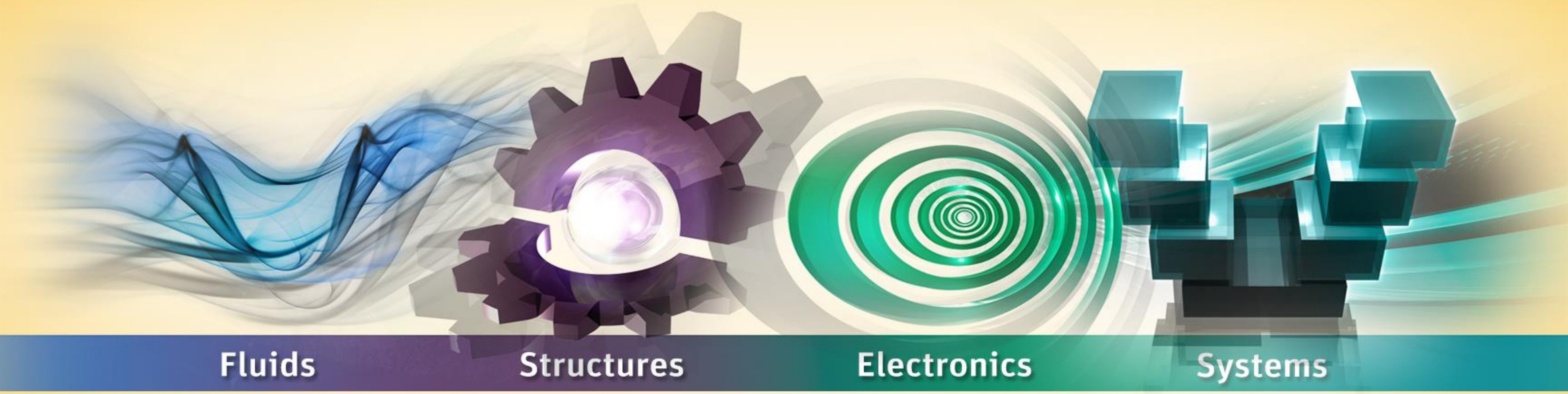
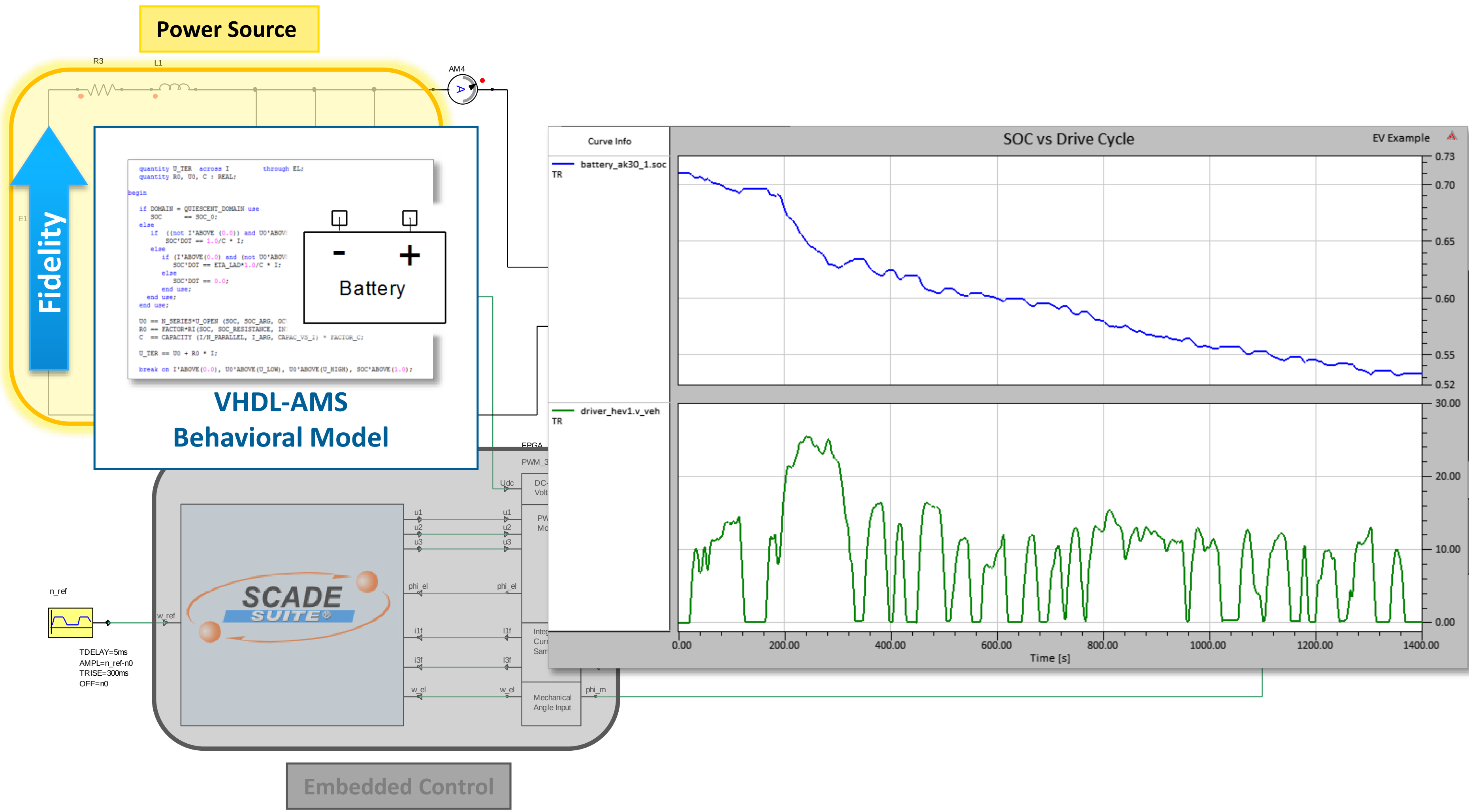
System Assembly & Analysis



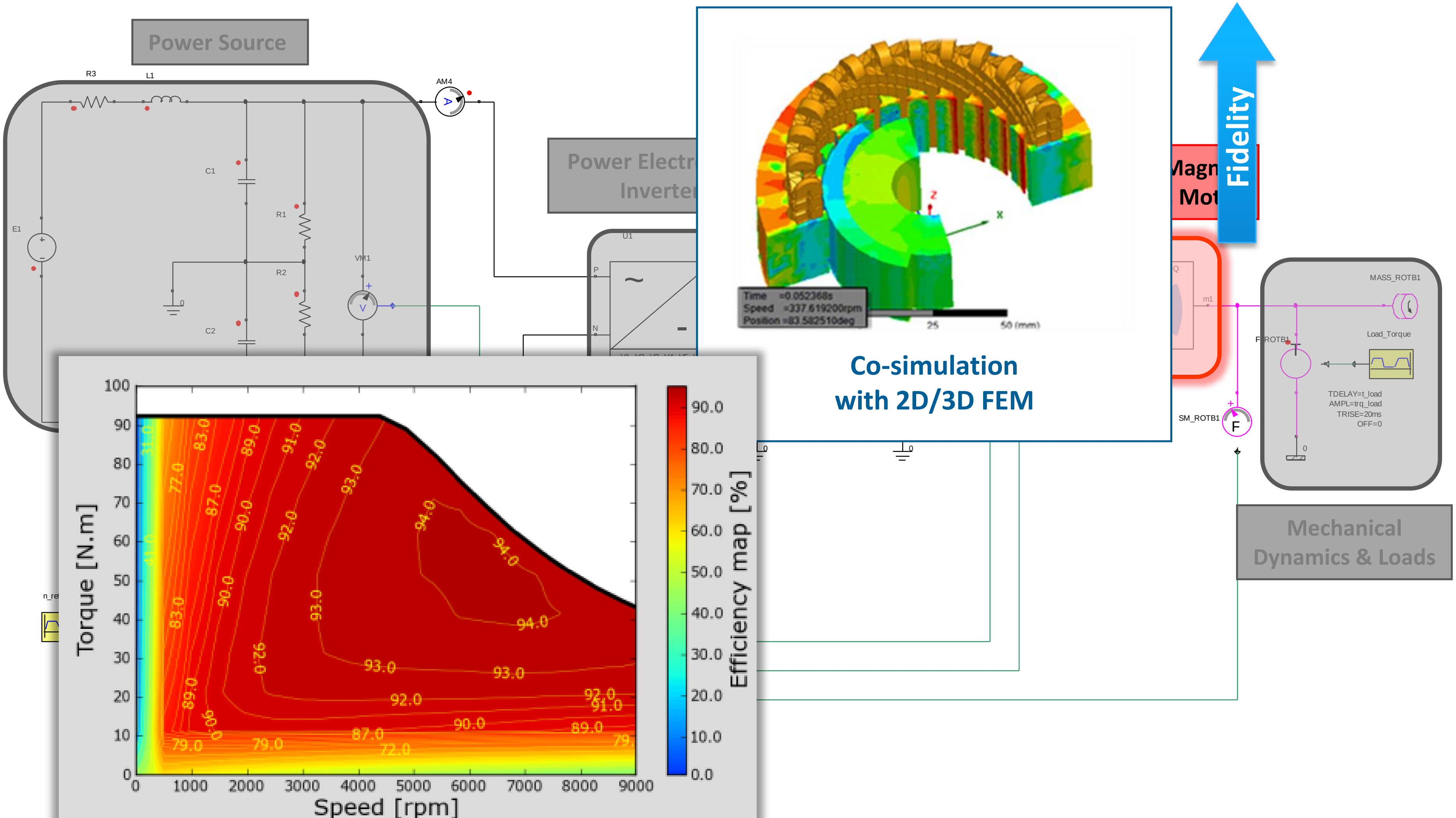
Assembling & Analyzing the System

Goal: Evaluate System Architecture, Size Key Components



Assembling & Analyzing the System

Goal: Characterize Motor Losses



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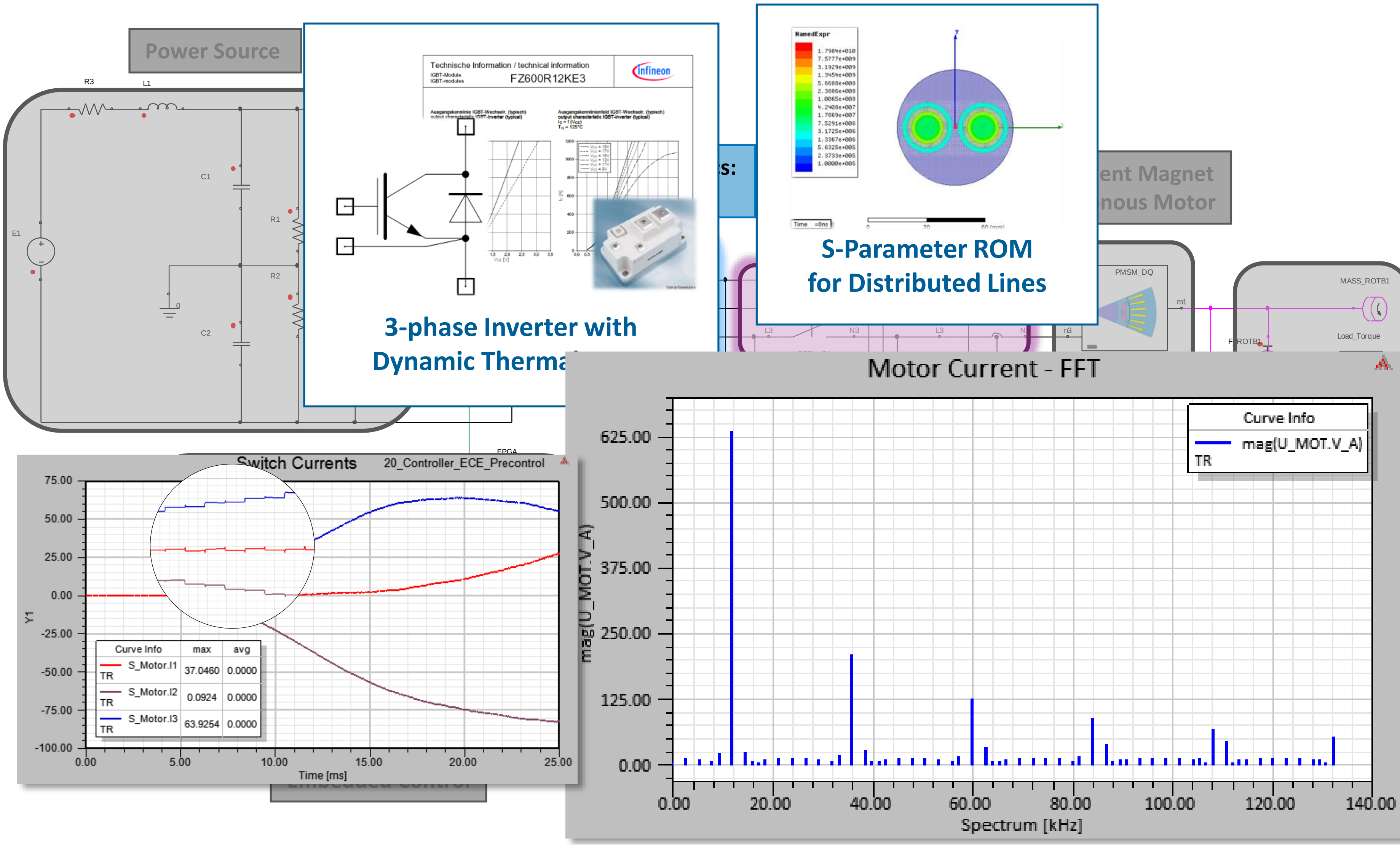
Assembling & Analyzing the System

Goal: EMC Prediction



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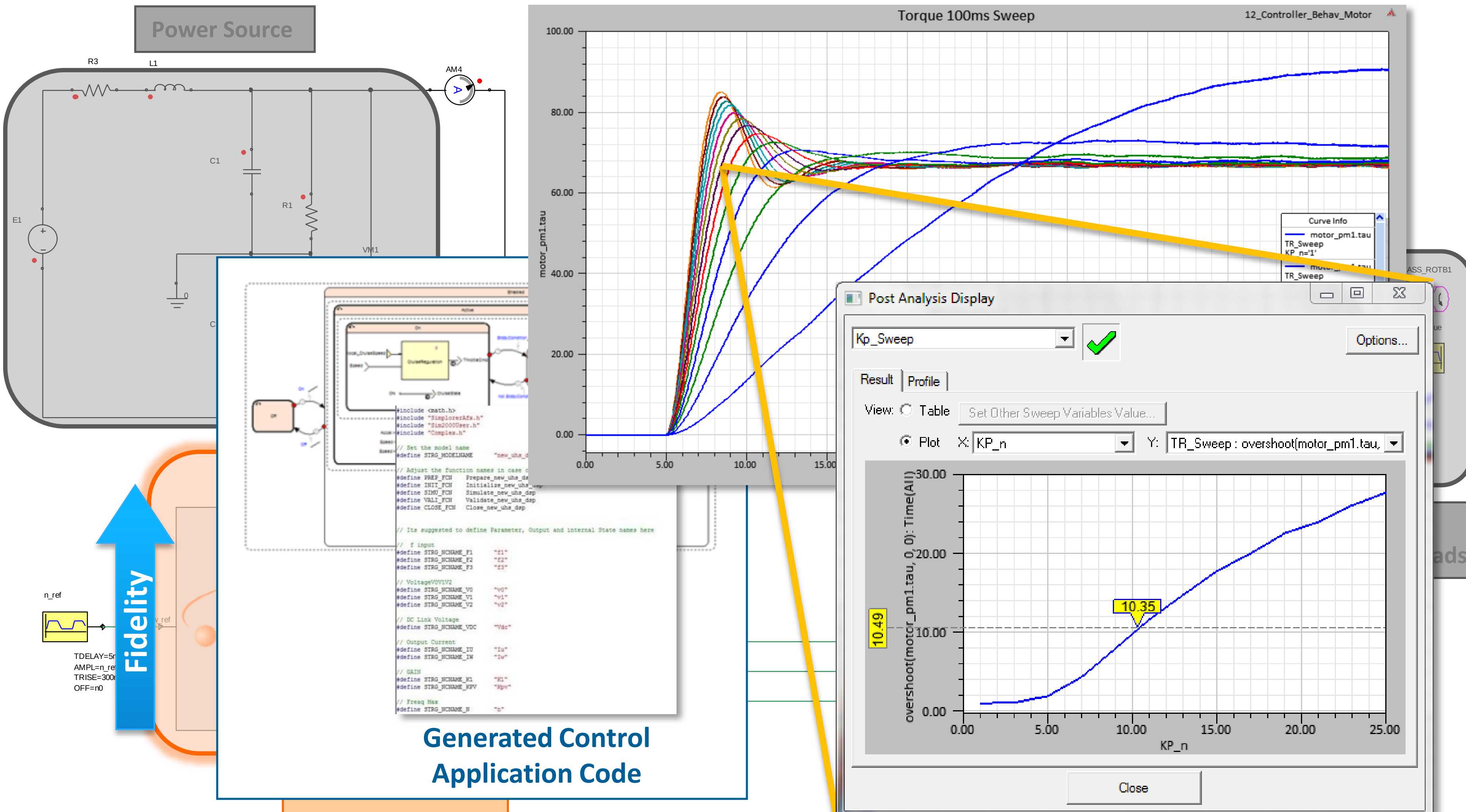
Assembling & Analyzing the System

Goal: MiL, SiL Testing / Calibration & Tuning



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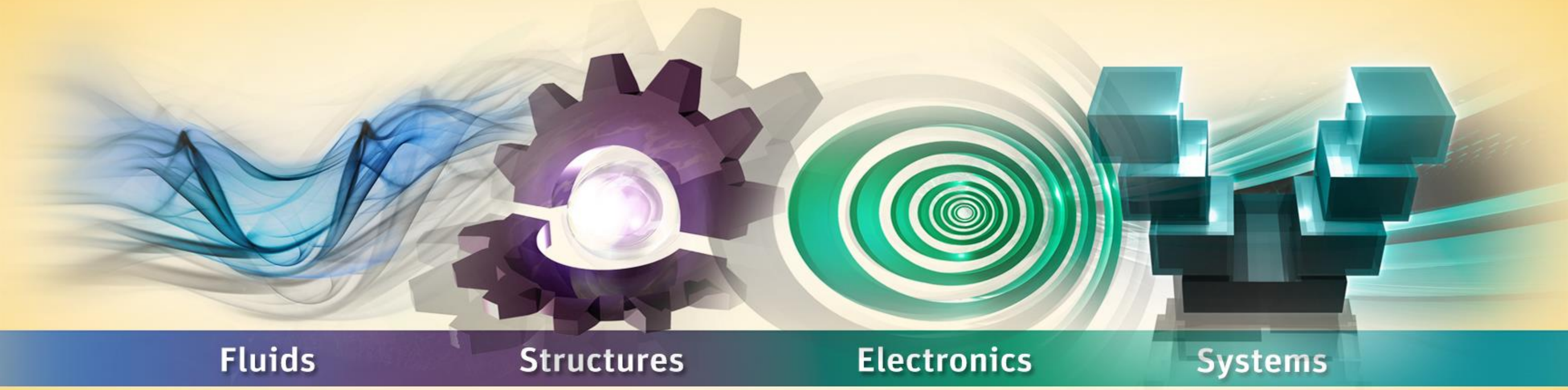
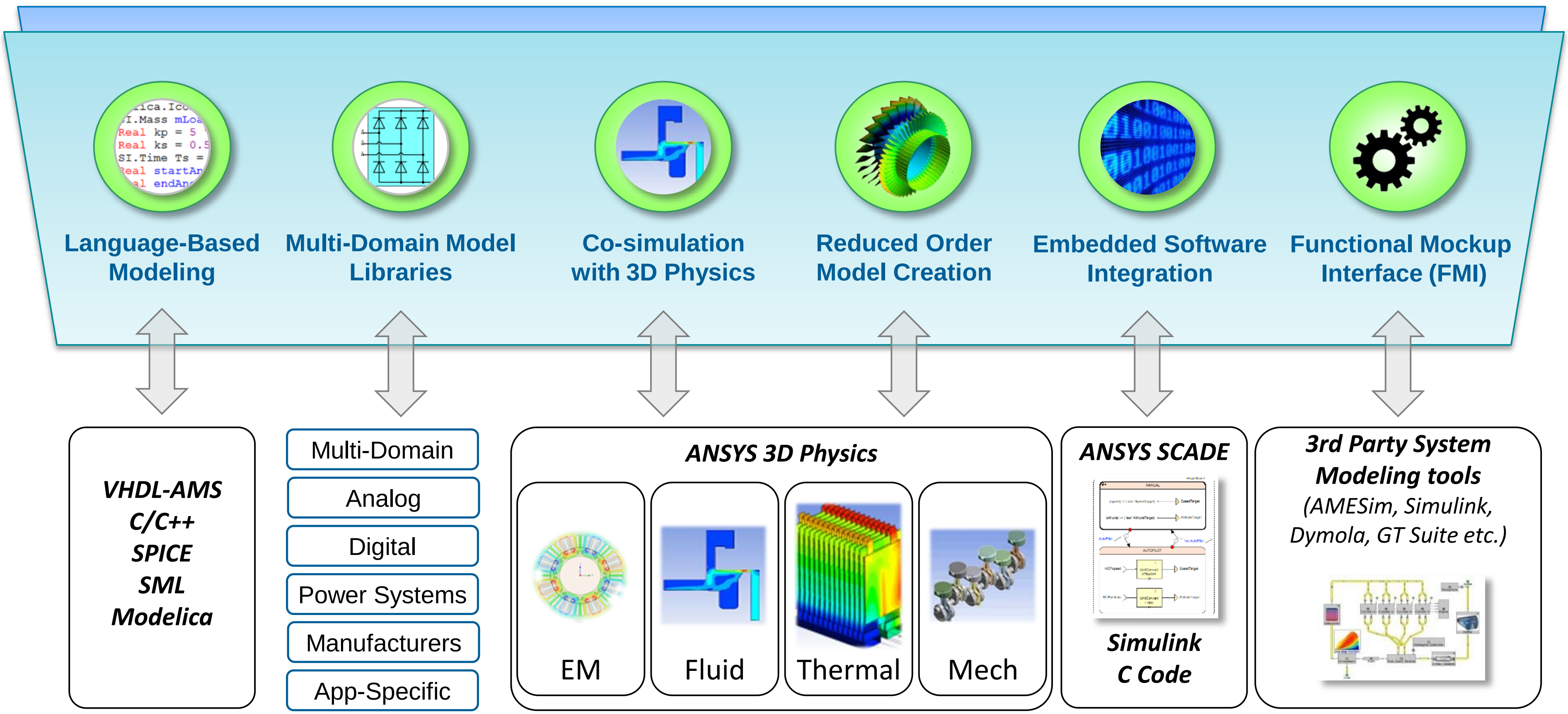
Simplorer for Systems

Modeling & Analysis



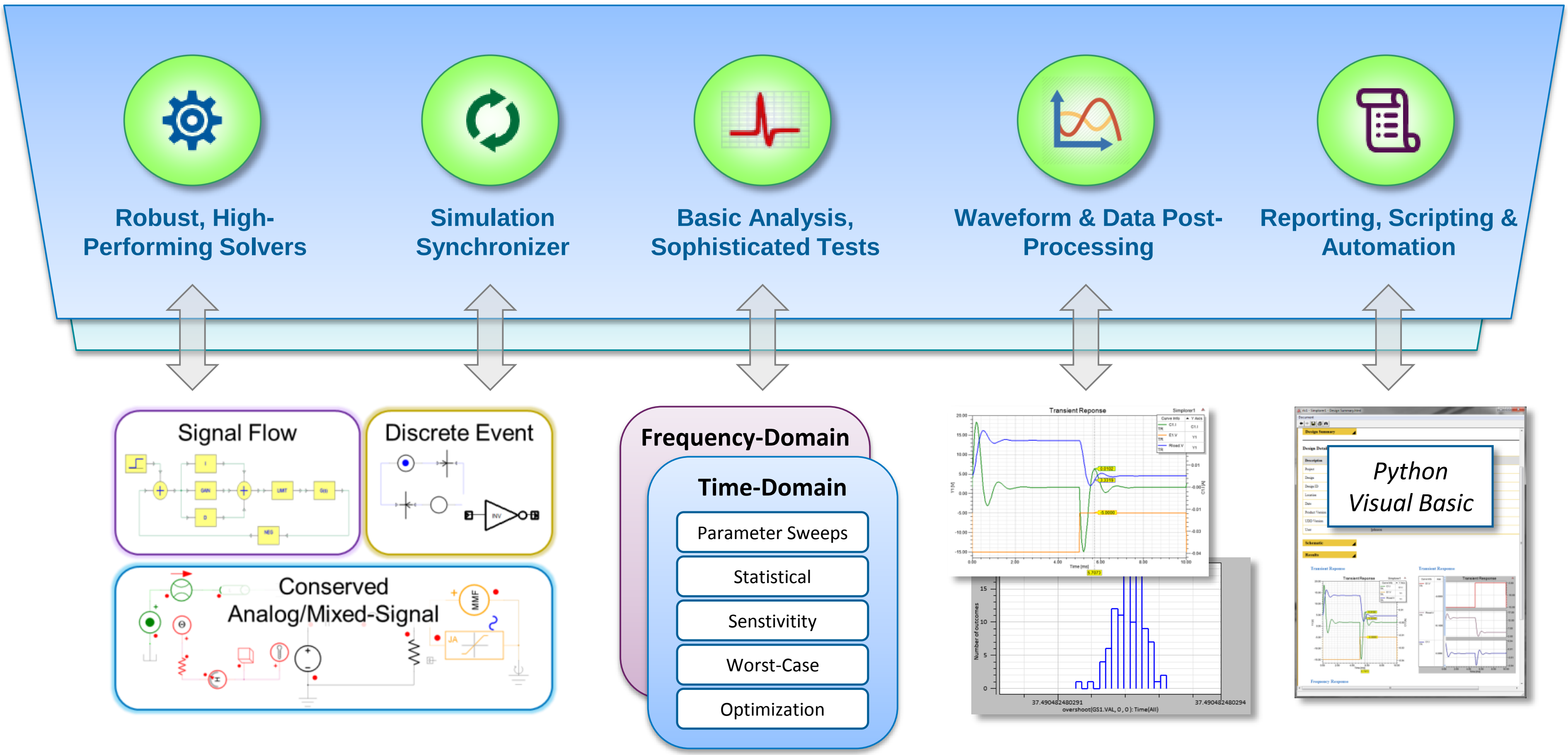
Modeling the System

Powerful Capabilities for Assembly and Reuse



Analyzing the System

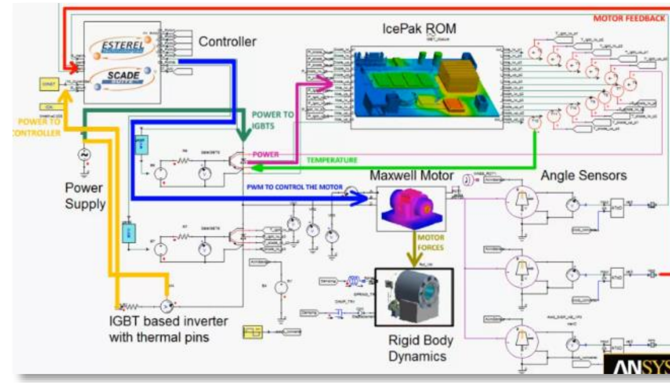
Robust Support for Simulation-Based Testing



ANSYS Simplorer

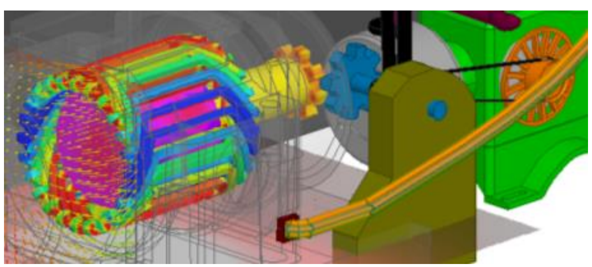
A Comprehensive platform for modeling, simulating, and analyzing virtual system prototypes

Spans electrical, electronics, mechanics,
thermo-fluids, and embedded software systems



Open Integration of existing tools

Full FMI compliance enables embracing and extending existing tools and libraries (Modelica and other FMI-compliant tools)

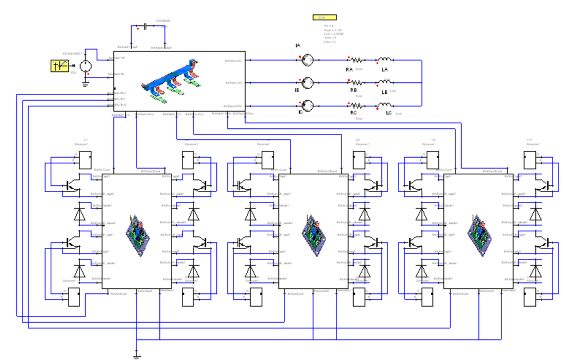


3-D Precision When You Need It

Cosimulation with 3-D solvers and reduced-order modeling (ROM) captures complex multi-physics interactions when precise system verification is required

Leader in simulation for power electronics and electrical systems

Rich modeling libraries and design automation designed especially for high-performance power electronics and electromechanical simulation



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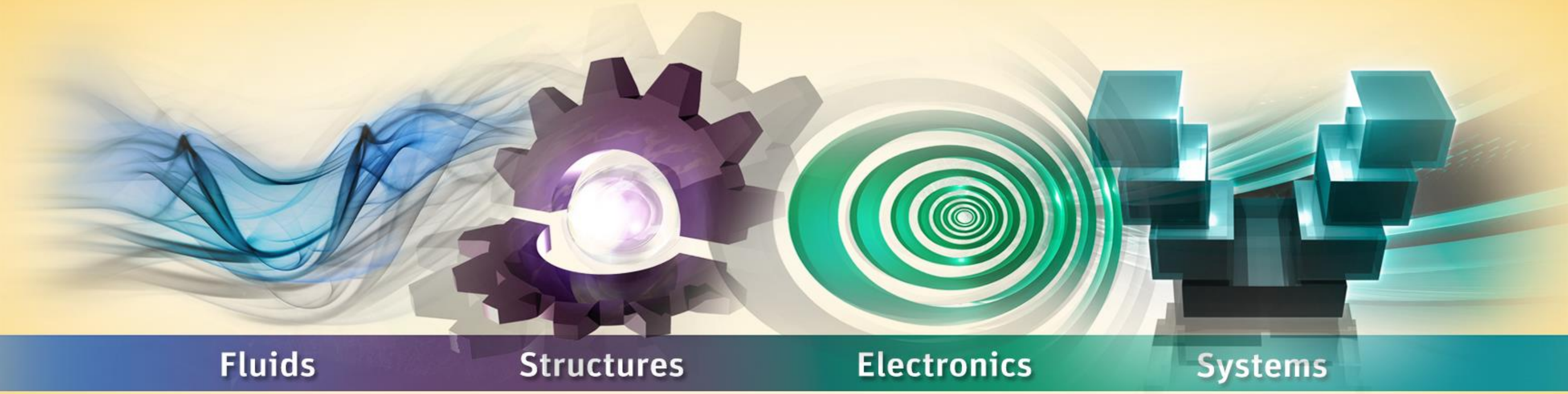
Thank You!



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